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I. METEOROLOGY

HYDROMET CENTER CELEBRATES FIFTIETH ANNIVERSARY

Moscow IZVESTIYA in Russian 27 Dec 79 p 2

[Article by V. Zakhar'ko: "At the Forefront of the Weather Service"]

[Text] In Moscow on 26 December a press conference devoted to the fiftieth anniversary of the USSR Hydrometeorological Scientific Research Center (GIDROMETTSENTR) was held.

The Gidromettsentr is currently the leading scientific, methodological and operational institution providing all branches of the economy with various types of hydrometeorological forecasts, whose accuracy and reliability are constantly improving.

The center consists of 24 scientific-research and scientific-operational divisions. Data are gathered here from about 6,000 weather and more than 700 aerological stations and from about 3,000 ships, commercial aircraft and artificial earth satellites. Every day as many as 10 million information symbols are processed here. The center also fulfills the functions of a world and regional center of the world-wide weather service.

Yu. Izrael', Chairman of the USSR State Committee for Hydrometeorology and Monitoring of the Natural Environment, Ye. Tolstikov, Deputy Chairman of the Committee, and M. Petrosyants, Director of the Gidromettsentr, spoke at the press conference.

[286-P]

II. OCEANOGRAPHY

INDUCED ALONG-CREST COMPONENT OF SEA WAVE MAGNETIC INDUCTION FIELD

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 20, No 1, 1980 pp 111-118

[Article by V. N. Savchenko and V. P. Smagin, Far Eastern State University, "Induced Along-Crest Component of Magnetic Induction Field in Sea Wind Waves"]

[Abstract] There is a discrepancy between the theory of the magnetic field induced by sea waves and experimental data. This is attributable to the fact that the theory is suitable for seas of the northern type, whereas experimental data relate to a sea of the southern type. In electromagnetic respects there is a dual difference between southern and northern seas: first, in southern seas conductivity varies sharply in the surface layer, whereas in northern seas it is virtually constant; second, in southern seas the horizontal component of the geomagnetic field becomes significant. In order to explain the experimental data it is only necessary to take the horizontal component into account. This is done by the authors, who use as a point of departure a hydrodynamic model of a wave proposed earlier (V. Yu. Semenov, MORSKIYE ELEKTROMAGNITNYYE POLYA, IZMIRAN, 1976, 3). The results of computations are presented in four tables. Table 1 gives a comparison of the amplitude values of the fields F_1 and F_2 for the vertical magnetic induction component induced by the vertical and horizontal components of the geomagnetic field respectively in seas with depths 5 and 10 m and for five different wavelengths: 5, 10, 20, 40 and 80 m. Table 2 gives the amplitude values of the fields F_3 and F_4 for the along-crest magnetic induction component with allowance for bottom conductivity. Table 3 gives a comparison of the vertical and along-crest field components. Table 4 shows the influence of bottom conductivity on the field component along the crest which begins to be reflected when $\lambda \geq 20$ m. In the overwhelming majority of cases the vertical component dominates over the component along the crest. For waves with $\lambda = 40$ and 80 m bottom conductivity increases the along-crest component and an increase in sea depth acts in this same direction. In certain instances the along-crest component can dominate over the vertical component: 1) if waves with a short crest are involved; 2) if the horizontal and vertical components are close in value. Tables 4; references 6; 4 Russian, 2 Western.
[216-5303]

TRANSFORMATION OF FINE STRUCTURE OF BOTTOM STRATIFIED CURRENT

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 40-49

[Article by Yu. G. Pyrkin and B. I. Samolyubov, Moscow State University, "Transformation of Fine Structure of a Natural Bottom Stratified Current Along the Axis of its Propagation"]

[Abstract] Over a period of years the authors carried out investigations of the structure of a stratified current, making it possible to analyze the process of transformation of the vertical distributions of water density and velocity of a bottom flow along its entire extent. Such a current is caused primarily by mechanical and in part by thermal stratification. The measurement apparatus and methods were described in earlier papers. The investigations were made in a deep water body of the canyon type with a bottom slope up to 10^{-2} with two flow regimes. Thermal density stratification of the waters exerted a significant influence on flow dynamics only during flow attenuation. Water temperature in the bottom flow was below its values in the above-lying water layers by not more than 0.8°C in the first flow regime and by 1.5°C in the second regime. The studies revealed internal currents in the body of the flow with a "stepped" density distribution. The authors give a detailed explanation of their appearance and degeneration. Also considered are the distributions of the Richardson number vertically and along the flow, the content of particles of different fractions suspended in the water and their coefficient of turbulent diffusion. Figures 3, tables 1; references 18: 14 Russian, 4 Western.

[239]

INCREASING NOISE IMMUNITY IN ECHO SOUNDING

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 170-177

[Article by Ye. V. Verzhbitskiy, L. M. Naymark, L. R. Merklin, Institute of Oceanology, "Investigations for Increasing Noise Immunity in Echo Sounding"]

[Abstract] The echo sounders carried aboard Soviet research vessels frequently do not ensure high-quality registry of depth, especially when the vessels operate under unfavorable hydrometeorological conditions, when great depths are involved and when there is considerable relief dissection. An effective decrease of some components of the noise background can be achieved by towing the acoustic reception system at some depth outside the wake. However, such systems used at the present time have a number of serious shortcomings, especially the absence of a directional effect in the plane perpendicular to the antenna axis. For highly precise

geomorphological investigations it is desirable to have an acoustic system which with respect to its noise immunity and resolution combines the advantages of a towed antenna and a narrow-directional echo sounder. The authors here propose a towed reception system which together with attenuation of the field of acoustic noise caused by movement of the ship, surface waves and other factors with respect to its noise immunity approaches narrow-ray echo sounders and is not costly. The described system consists of two antennas and an asynchronous accumulation unit. Such a system also has directional properties in the plane perpendicular to the towing axis. Towing and lowering-raising operations do not require special equipment and do not require modification of the ship's hull. The assembly is connected to any standard shipboard echo sounders without changing the design of the echo sounders themselves. The system advantageously supplements any digital echo sounding devices, making possible more reliable discrimination of the reflected signal, and accordingly, the more reliable operation of devices for coding data on the depth of bottom relief. Use of such a system is especially useful in geomorphological investigations of regions with strongly dissected relief, such as in areas of mid-oceanic ridges and trenches. Figures 6; references 8: 6 Russian, 2 Western.

[239]

USE OF PHOTOTELEGRAPHIC APPARATUS IN SEISMIC PROFILING

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 167-169

[Article by G. N. Lunarskiy, Institute of Oceanology, "Use of FAK-P Phototelegraphic Apparatus as a Recorder for Seismic Profiling Systems"]

[Abstract] FAK-P phototelegraphic apparatus is frequently used in continuous seismic profiling systems. The FAK-P is designed for the reception of textual material, weather charts, black-and-white and half-tone images with reproduction on electrochemical paper. This article describes the modifications of the apparatus which make its use feasible for use in seismic profiling. The electric circuitry of a special amplifier-converter is shown as Fig. 2. It consists of an amplifier, phase inverter, balance modulator and generator of an auxiliary frequency. The use of this converter makes it possible to ensure registry of the spectrum of seismic frequencies from 2.5 to 300 Hz without alteration of the apparatus. Figures 2; references: 6 Russian.

[239]

METHOD FOR COMPUTING ELECTROMAGNETIC FIELDS IN WORLD OCEAN

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 20, No 1, 1980 pp 106-110

[Article by B. Sh. Zinger and E. B. Faynberg, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Method for Computing Electromagnetic Fields in World Ocean"]

[Abstract] Deep electromagnetic sounding is carried out for determining the conductivity of deep layers in the earth on the basis of interpretation of observations of the geomagnetic field at its surface. Field variations with periods of several hours are considerably distorted by the conducting shell -- the earth's oceans and sedimentary cover. As a simplification of the problem A. T. Price (QUART. J. MECH. AND APPL. MATH., 2, 283, 1949) proposed for fields whose depth of penetration into the ocean exceeds the depth of the ocean that the latter should be regarded as a thin film. He derived an equation describing electromagnetic induction in a thin film in terms of the stream function

$$\operatorname{div}(S^{-1} \operatorname{grad} \psi) = i\omega\mu_0(B_n^s + B_n^e). \quad (1)$$

Despite the qualitative simplification of the problem with a change from a conducting layer of finite thickness to a thin film, the problem remains complex. Price proposed two iteration methods for solving equation (1). A universal method for solving the Price equation, convergent at all frequencies, was proposed by B. A. Hobbs and A. M. M. Brignall, GEOPHYS. J. RES. ASTRON. SOC., 45, 527, 1976. But this method has shortcomings. In the method it is necessary to retain not only the current result, but also the results of all preceding iterations. This results in a loss of the simplicity characteristic of the iteration method, as well as the property of self-correctability. Accordingly this paper gives a new, simple iteration method for solution of the problem which is free of these shortcomings. As its zero approximation use is made of a system of currents induced in a homogeneous thin film and then necessary refinements are introduced. The resulting iteration series converges at all frequencies. References 5: 3 Russian, 2 Western.
[216-5303]

FLUCTUATIONS OF TEMPERATURE FIELD IN UPPER LAYER OF OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 2, 1980 pp 186-194

[Article by N. N. Korchashkin and I. D. Lozovatskiy, Institute of Oceanology, "Statistical Patterns of Fluctuations of the Temperature Field in the Upper Layer of the Ocean"]

[Abstract] Using data from microstructural measurements in different regions of the Pacific and Indian Oceans the authors have examined the distributions of probabilities of statistical characteristics of the vertical

structure of small-scale temperature inhomogeneities. It was found that the distribution functions for thicknesses of layers with an approximately constant level of mean square temperature fluctuations s_T can be described by a log-normal law, whereas the distribution of the s_T values themselves is uniform in the interval $1.5 \cdot 10^{-3}$ – $1.3 \cdot 10^{-2}$ °C. Such a character of the statistical patterns of the vertical structure $s_T(z)$ corresponds to cases when the principal parameter determining the regime of small-scale fluctuations T' is the mean vertical temperature gradient. Computations of the two-dimensional probability distribution function for thicknesses of layers and the s_T values corresponding to them indicated that the mechanisms of generation of intensive small-scale temperature fluctuations in the thermocline have a local character. Tables 2, figures 5; references 13: 12 Russian, 1 Western.

[243]

SPECTRAL BRIGHTNESS AND ITS RELATIONSHIP TO PHYTOPLANKTON CONTENT

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 142-147

[Article by A. F. Sid'ko, A. D. Aponasenko, N. A. Frank, L. A. Shur and F. Ya. Sid'ko, Physics Institute imeni L. V. Kirenskiy Siberian Department Academy of Sciences, "Study of Spectral Brightness and its Relationship to the Content of Phytoplankton"]

[Abstract] During the summer and autumn months of 1975-1977 the authors determined the spectral brightness coefficients, water transparency, content and distribution of phytoplankton and other hydrooptical and hydrobiological indices of Krasnoyarsk Reservoir for the purpose of studying the dependence of spectral brightness on water transparency and other hydrooptical characteristics, and also on the content of chlorophyll in phytoplankton. It was found that the spectral brightness coefficients for the reservoir correlate with the relative translucency T of the water, its content of phytoplankton and other hydrophysical characteristics. The distribution of phytoplankton in the surface waters of the reservoir is nonuniform and to a considerable degree is governed by water temperature and transparency. In spring the maximum chlorophyll concentration in the surface waters is in the Cheremushek region (90-95 km from the dam); in autumn this maximum is displaced in the direction of the backwater (285 km), where the depth of the reservoir is less and where its width is greater. The maxima of the spectra of the brightness coefficients and the attenuation minima are in the region $\lambda = 570$ -580 nm. Optical remote methods for studying the spectral brightness of surface waters can be used in studying the seasonal dynamics of phytoplankton development and in obtaining information on some hydrooptical characteristics. Figures 4; references 13: 10 Russian, 3 Western.

[239]

METHOD FOR DETERMINING SLOPE DISTRIBUTION FUNCTION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 2, 1980 pp 178-185

[Article by V. I. Titov, Institute of Applied Physics, "Accuracy in Determining the Slope Distribution Function for a Sea Surface from the Sun's Glitter"]

[Abstract] The pattern of glitter on the sea surface can be used in determining the slope distribution function (SDF). This pattern carries information on the height of waves, wind velocity over the sea surface, different kinds of large-scale hydrodynamic disturbances (such as internal waves, nonuniform currents) and films of surface-active substances which can exert an influence on the parameters of wind waves. A knowledge of the slope distribution function is also necessary for predicting the visibility of underwater objects through the water-atmosphere discontinuity. However, the reliability of the information extracted from the optical image of the sea surface is dependent on the accuracy in measuring the SDF. In this article the author describes a method for measuring the SDF which is based on observations of the sun's glitter using a narrow-angle detector with different sighting directions. It is shown that the accuracy in measuring the SDF is determined by the ratio of the scales of temporal and spatial averaging of the pattern of glitter to the temporal and spatial correlation scales of the glitter. The glitter correlation function is introduced; it is used in determining the sought-for correlation scales. The known spectra of sea waves are used in computing the dispersion of SDF fluctuations for different averaging times and areas for glitter and for different wind velocities over the sea. The paper has these sections: 1. Derivation of formula for energy incident in detector when observing glitter, 2. Determination of mean value and fluctuations of received energy, 3. Determination of glitter correlation scales, 4. Numerical computation of energy dispersion and glitter correlation scales. Figures 4; references 9: 4 Russian, 5 Western.

[243]

BEHAVIOR OF A MIXED LAYER IN A HOMOGENEOUS FLUID

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 2, 1980 pp 197-200

[Article by S. I. Voropayev, B. L. Gavrilin, A. G. Zatsepin and K. N. Fedorov, Institute of Oceanology, "Laboratory Study of Behavior of a Mixed Layer in a Homogeneous Fluid"]

[Abstract] A laboratory study of the dynamics of the upper mixed layer in the ocean is described. Earlier studies of this type have revealed that in the initially unperturbed fluid a turbulent layer is formed and as a

result -- a well-mixed layer, an analogue of the upper mixed layer, separated from the remaining (virtually unperturbed) fluid by a sharp discontinuity. Later the thickness of the mixed layer increases and the discontinuity withdraws from the oscillating grid at a rate called the entrainment rate. Most such studies have been made with a stratified fluid. Virtually no such studies have been made with a fluid of uniform density. This paper was written to confirm or refute earlier studies of this nature. The laboratory apparatus was described in an earlier paper. Essentially it consists of a basin with plastic walls and a rigid metal frame measuring 30 x 30 x 50 cm and filled with distilled water at room temperature to a standard level. Two types of grids of different configuration were used for mixing. Both constant and variable grid oscillation frequencies were used. It was found that the degree of degeneration of turbulence and the rate of entrainment are essentially dependent on the configuration of the grid used for mixing. The influx of turbulent energy from a grid oscillating at a constant frequency to the initially unperturbed fluid does not remain constant but decreases with time. There is a self-similar distribution of the turbulent energy in a fluid which is homogeneous in density. It is entirely probable that in the ocean, for example, in the collapse of wind waves, the influx of turbulent energy to the fluid does not remain constant (with a constant friction velocity at the surface), but decreases with time. Figures 4, tables 3. References 5: 2 Russian, 3 Western.

[243]

INDUCED LONG WAVES IN LAYER OF ROTATING STRATIFIED FLUID

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 13-18

[Article by A. A. Zaytsev, Atlantic Division Institute of Oceanology, "Induced Long Waves in a Layer of a Rotating Stratified Fluid"]

[Abstract] Within the framework of linear theory a study was made of three-dimensional induced movements of a rotating layer of a stratified fluid. The movements are generated by a concentrated source. The problem is formulated as follows. Assume that a stably stratified fluid of a constant depth h fills the region $-h > z > 0$ and rotates about the vertical axis z with the angular velocity $f/2$. At the bottom the fluid is bounded by a solid horizontal bottom, and above by a free surface at which atmospheric pressure is not operative. The Väisälä-Brent frequency is considered constant and equal to N . The Boussinesq and quasistatics approximations are used. The mean density of the fluid is considered equal to unity. At a stipulated point within the fluid a concentrated source becomes operative beginning at the time $t = 0$. The paper studies cases of pulsed and periodic sources and also a source operative during a finite time interval. The process of development of the long-wave field and its transformation into a geostrophic current are studied. References: 10 Russian.

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SHIPBOARD LASER SPECTROFLUOROMETER

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 148-152

[Article by G. S. Karabashev and A. A. Timoshevskiy, Atlantic Division Institute of Oceanology, "Shipboard Laser Spectrofluorometer"]

[Abstract] A knowledge of the fluorescence time of substances dissolved and suspended in sea water is necessary for developing new methods for detecting anthropogenic contaminations, biogenous particles and other impurities on the basis of their fluorescence, including the laser sounding method. The determination of fluorescence time of any impurity is of direct scientific interest since this parameter carries information on the internal state of matter. The fluorescence time of many substances in the sea has not yet been studied. It is particularly important to know the fluorescence time of dissolved organic substances of natural origin. They are a source of the fluorescence background in the fluorometric determination of other impurities since they occur everywhere in the ocean and have broad fluorescence bands excited in the UV and visible spectral regions. The shipboard laser spectrofluorometer described in this paper has the following main components: pulsed laser, monochromator and strobing oscilloscope. A block diagram of the instrument in the text identifies 19 components and serves as the basis for a detailed description of its structure and functioning. The moments method is employed in determining fluorescence time. The total time required in making one fluorescence time determination is 10-15 minutes. The instrument was first used during the 20th voyage of the "Dmitriy Mendeleev." Data on measurement errors and the operational characteristics are given. The principal results of its use on the "Mendeleev" are given by G. S. Karabashev in DOKLADY AN SSSR, Vol 244, No 5, 1979. Figures 3; references: 4 Russian.

[239]

SPECTROPHOTOMETER FOR STUDYING LIGHT EXTINCTION BY SEA WATER

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 153-157

[Article by V. F. Bochkov, O. V. Kopelevich and B. A. Krivan, Central Design Bureau USSR Academy of Medical Sciences and Institute of Oceanology, "Spectrophotometer for Investigating Light Extinction by Sea Water in Visible and Ultraviolet Spectral Regions"]

[Abstract] The article describes a laboratory instrument for measuring light extinction by sea water ("Okean" instrument), created by the Central Design Bureau Academy of Medical Sciences at the request of the Institute of Oceanology. Figure 1 in the text shows the external appearance of the instrument; Fig. 2 is an optical diagram with 19 components

identified; Fig. 3 is a block diagram. The latter two figures serve as the basis for the detailed textual description of the instrument and its functioning. The spectral range of instrument operation is 250-600 nm; monochromator dispersion is $5 \text{ nm} \cdot \text{mm}^{-1}$. There is a device making it possible to set any scanning interval within the indicated spectral range. The rate of scanning of the spectrum is 6, 12, 30, 60 and $120 \text{ nm} \cdot \text{min}^{-1}$. The registry tape can be moved backward and successively measured extinction spectra can be superposed on one another. The instrument was used on the 61st voyage of the "Vityaz'," aboard which about 400 sea water samples were analyzed. For typical ocean waters the total error in determining the extinction index is 0.02 m^{-1} . Examples of extinction spectra are given for different waters. The greatest differences between the investigated samples are in the short-wave part of the spectrum and therefore precisely this part of the spectrum should be used in the differentiation of waters with respect to their light extinction properties. Data from the "Okean" instrument are of particular value in this respect because they cover both the visible and near-UV parts of the spectrum in which measurements are usually not made. Figures 4; references: 3 Russian.

[239]

VARIATION OF LITHOSPHERIC THICKNESS IN VERNADSKIY FRACTURE ZONE

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 72-79

[Article by V. G. Budanov, A. G. Gaynanov, I. V. Kolezhuk, V. R. Melikhov, Ye. G. Mirlin, L. P. Polyakova and O. N. Solov'yev, All-Union Scientific Research Institute of Geophysics, Moscow State University, Marine Hydrophysical Institute Ukrainian Academy of Sciences and Institute of Oceanology. "Variation in Thickness of Lithosphere in Vernadskiy Fracture Zone"]

[Abstract] This paper presents a multisided interpretation of data collected in the Vernadskiy fracture zone at 8°N in the equatorial Atlantic. GMKP gyrostabilized gravimeters were used in gravity measurements. The measurement error was $\pm 5 \text{ mgal}$. Gravimetric maps were plotted for free-air anomalies with isolines each 15 mgal and with a 20-mgal interval for anomalies in the Bouguer reduction. Bouguer anomalies were computed with a correction for bottom topography with a density of the intermediate layer $2.67 \text{ g} \cdot \text{cm}^{-3}$. Magnetic measurements were made with APM-3 sea proton magnetometers with an accuracy to $2\text{-}3 \text{ gamma}$. Along some runs seismic investigations were made by the reflected waves method. These results and others were taken into account in the interpretation of gravimetric data. Figure 1 is a map of bottom relief of the Vernadskiy fracture zone; Fig. 2 is a map of gravity anomalies in the Bouguer reduction; Fig. 3 is a diagram of magnetic anomalies; Fig. 4 is a section of the crust and upper mantle along 38°W ($6^\circ 30'\text{--}11^\circ \text{N}$). The gravity anomalies (free air) almost completely

conform to the peculiarities of bottom relief. A latitudinal strike is characteristic of bottom relief, this being manifested in both the free-air and Bouguer anomalies. The crust-mantle section revealed the presence of three layers, each of which is described in detail. In the Bouguer anomalies over the fracture zone there is a regional minimum which is caused by a change in the thickness of the lithosphere at the boundaries of plates of different age. The computed depths of the bottom of the lithosphere are close to the theoretical determinations. Figures 4; references 7: 6 Russian, 1 Western.
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ESTIMATE OF FRACTION OF SEA SURFACE COVERED BY FOAM

Moscow OKEANOLOGIYA in Russian Vol 20, No 1, 1980 pp 50-56

[Article by O. V. Kopelevich and E. M. Mezhericher, Institute of Oceanology, "Estimate of the Fraction of Coverage of the Sea Surface by Foam from the Spectral Brightness of Visible Radiation"]

[Abstract] An estimate of the fraction of the ocean surface covered by foam is of importance for computing the radiation balance since the presence of foam considerably changes the albedo of the ocean-atmosphere system. Such an estimate is important for obtaining information on wind velocity in the near-water layer. The presence of foam must be taken into account in the remote measurement of temperature and determination of the content of chlorophyll on the basis of ascending radiation. In this problem it is important to estimate the fraction of coverage of the surface by foam from spectral brightness values in the visible region. Accordingly, the authors have developed such a method. The following subjects are considered: influence of foam on brightness of ascending radiation, method for estimating fraction of coverage by foam, application of method to actual observational data and influence of foam on possibility of "inversion" of spectral values of brightness of ascending radiation. The essence of the method, fully validated here, is based on spectral values of brightness of the sea and sky and irradiance in the visible region. However, much remains to be done in improving the method. In particular, this involves serious investigation of the optical characteristics of foam formations of different types. In the case of remote studies an increase in accuracy requires a combination of measurements in the visible and microwave ranges. Figures 2, tables 1; references 19: 13 Russian, 6 Western.

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FORM OF SOUND SCATTERING INDICATRIX IN PRESENCE OF SEA SURFACE ROUGHNESS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 2, 1980 pp 201-203

[Article by Ye. A. Kopyl and S. D. Chuprov, Acoustics Institute, "Form of the Sound Scattering Indicatrix in Presence of Large Irregularities of the Sea Surface Under Shadowing Conditions"]

[Abstract] The scattering indicatrix is the angular dependence of intensity of the field reradiated by an uneven surface. In a general case it is a function of the four angles characterizing the direction of the wave vectors of incident and scattered radiation. This study is limited to an examination of a section of the indicatrix by the incidence plane $I(\chi_1, \chi_2)$, which as a function of two variables -- the glancing angles of the incident χ_1 and scattered χ_2 waves -- determines some geometrical surface. The paper is devoted specifically to an investigation of the form of this surface with small χ_1 and χ_2 . The authors examine sound scattering on an absolutely soft statistically uneven isotropic surface with a normal distribution of rises and slopes. Particular attention is given to the form of the indicatrix for the case of strong shadowing. A number of special cases are considered. Figures 2; references: 2 Russian.

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III. TERRESTRIAL GEOPHYSICS

FRACTURING MECHANISM AT HYPOCENTERS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 3, 1980 pp 602-606

[Article by A. V. Solonenko, Corresponding Member USSR Academy of Sciences V. P. Solonenko and N. V. Solonenko, Institute of the Earth's Crust, Siberian Department USSR Academy of Sciences, "Fracturing Mechanism at Hypocenters and its Seismogeological Consequences"]

[Abstract] In investigating strong ($M \geq 6.5$, $I_0 \geq 9$ units) earthquakes in the Baykal-Mongolian seismic zone the authors repeatedly observed a nonuniform propagation of the most dangerous residual and dynamic seismotectonic and seismogravitational deformations of the earth's crust and ground. In all cases there was a marked decrease in earthquake intensity away from seismogenic faults. These peculiarities had no explanation in geological structures and the structure of the earth's crust of pleistoseist regions. It was postulated that they can be related to the direction and velocity of development at hypocenters. In order to compute these parameters the authors propose a method for determining the velocity and direction of fracturing at earthquake foci, taking into account the Doppler seismic effect and based on an analysis of the distribution of the apparent periods of the maximum displacements of elastic oscillations at stations in the regional network. In the proposed method, in order to exclude the uncertainties related to the lack of data on the parameters of seismic oscillations emanating from a source, and also on the nature of station distortions exerting an influence on the spectral pattern of registered oscillations, for determining the velocity of fracturing and its direction it is necessary to use observations of pairs of earthquakes (station influence is excluded) by two seismic stations (focal influence is excluded). The operations involved in application of the method are outlined. As an example of the practical application of the method the article gives the results of determination of the directions of fracturing in the focal zones of earthquakes in the northern part of the Baykal rift zone. Figures 1; references 15; 11 Russian, 4 Western.

[206-5303]

PETROLEUM AND GAS RESOURCES IN SOUTHERN UKRAINE

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B. GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 2, 1980 pp 11-14

[Article by Academician Ukrainian Academy of Sciences G. N. Dolenko, A. I. Parylyak and I. P. Kopach, Institute of Geology and Geochemistry of Fuel Resources Ukrainian Academy of Sciences, "General Evaluation of Petroleum and Gas Resources of Maykop Deposits in the Southern Ukraine"]

[Abstract] Formations of the Maykop series are widely developed in the southern Ukraine. The commercial productivity of the Maykop stratum is well known. In the southern Ukraine the deposits in the Dzhankovskoye, Mezhdvodnenskoye, Golitsinskoye, Strelkovoye, Yuzhno-Sivashskoye, Fontanovskoye, Vladislavovskoye, Moshkarevskoye and Kuybyshevskoye uplifts are associated with the Maykop deposits. The data presented in this paper are indicative of the excellent prospects for finding additional petroleum and gas resources in Maykop deposits in the southern Ukraine, as reflected in a full-page map accompanying the text (73 formations are plotted). A thorough analysis of the available geological and geophysical data indicates that the most favorable combination of collectors, caps and conditions for the formation and preservation of deposits of hydrocarbons are in the western part of the Severo-Krymskiy, Tsentral'no-Azovskiy and Indolo-Kubanskiy petroleum and gas regions. Promising areas include the Severo-Azovskiy, Zapadno-Prichernomorskiy, Indolo-Kubanskiy and Prichernomorsko-Prirazovski regions. The following uplifts seem to be the most promising: Gamburtsev, Sel'skiy-1, Arkhangel'skiy, Shmidt, Morskoye-1, Obruchev, Prirazlomnoye, Severo-Kerchenskoye, Korolevskoye, Slyusarevskoye, Krasnopol'skoye and others. Figures 1; references: 11 Russian.

[280]

PROPERTIES OF RAYLEIGH WAVE IN HORIZONTALLY INHOMOGENEOUS REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980 pp 30-41

[Article by A. N. Yakobson, Institute of Physics of the Earth, "Temporal Properties of Rayleigh Wave in Horizontally Inhomogeneous Okhotsk Region"]

[Abstract] A study was made of the dependence of the periods and envelope of the intensity of a Rayleigh wave on apparent velocity -- the temporal properties of the wave. The investigation was based on 420 seismograms of 135 earthquakes occurring during the years 1966-1968, for the most part in the Kurile arc, registered by six stations. Focal depths were as great as 50 km. The magnitude range was 4.5-6.5. The article is accompanied by a map of the Okhotsk region showing seismic stations, epicenters, outlines of principal structures and other features. The analysis of these data

made it possible to relate the observed properties to the influence of some geological features in a region with a relatively well-studied structure. It is shown that the temporal properties of the Rayleigh wave are sensitive to the horizontal inhomogeneity of the medium. Horizontal inhomogeneities in the earth's crust and upper mantle can be investigated by studying the temporal characteristics of surface waves. The analysis of Rayleigh wave records for paths across the Okhotsk Sea region revealed peculiarities arising under the influence of definite characteristics of medium structure: a) screening of short periods by the thick sedimentary absorbing material of the South Okhotsk depression; b) instability of dispersion on paths along the boundary of the unlike blocks of the South Okhotsk depression and Sakhalin-Hokkaido; c) monochromatic sectors and instability of the phase M_R , evidently related to horizontal refraction and interference of oscillations scattered by small random inhomogeneities. Figures 7, Tables 4; references: 11 Russian. [272]

METHOD FOR OPTIMUM EVALUATION OF SOURCE MAGNITUDE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980 pp 83-89

[Article by Yu. N. Shtemenko, Institute of Physics of the Earth, "Optimum Evaluation of Source Magnitude Using Data from a Combined System of Stations"]

[Abstract] The problem of registry of disturbances from a weak source of oscillations is difficult, but a still more complex problem is that of evaluating the parameters of a weak source. A combined system of stations could be used in solving this problem. Not all network stations can register weak signals, but the data of those which register them must be included in the joint processing for evaluating source intensity. In addition, there must be calibration of each group of stations on a magnitude scale with reliance on data from the network and other groups of stations. By locally combining different network stations and regarding them as groups it is possible, relying on the others, to study the dynamic characteristics of the medium. The author examines the following in detail: a) Probable evaluation of magnitude for a combined system of stations, b) Dispersion of probable evaluation of magnitude, c) Station magnitude corrections for network and groups of stations. The author has devised a method for obtaining probable evaluations of magnitude and station corrections when using data from a combined registry system. Simplified variants of the evaluations are considered; these are used in dependence on the volume of data on interference, signals and their covariations. The evaluations are asymptotically unbiased and have a minimum dispersion. Using the expressions derived for the dispersions of magnitudes it is possible to judge the nature of decrease in dispersions in dependence on the number of seismic stations in the network

and the number of stations in the grouping. At present there are no combined systems in seismology. A combined system is not synthesized in order to obtain stable values of magnitude station corrections, but for finding evaluations with a minimum dispersion and to establish relationships between elements of the system. Station magnitude corrections are covariant. On the basis of the nature of the covariations it is possible to evaluate within what epicentral distance limits the magnitude corrections behave stably and in what limits they do not. References: 5 Russian.
[272]

EFFECTIVENESS OF OPTIMUM MAGNITUDE EVALUATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980
pp 90-96

[Article by Yu. I. Shtemenko and V. I. Tsibul'skiy, Institute of Physics of the Earth, "Effectiveness of Optimum Magnitude Evaluations"]

[Abstract] The magnitudes of earthquakes determined using data for individual stations or using data from different networks of stations can differ greatly. The same can be said concerning the magnitude of shots. The comparison and tie-in of magnitudes is a complex problem. In earlier studies by the author (GEOL. I GEOFIZ., No 2, 1976; No 10, 1975; VYCHISLITEL'NAYA SEYSMOLOGIYA, No 9, 1975; IZV. AN SSSR, FIZIKA ZEMLI, No 3, 1980) it was possible to obtain optimum magnitude evaluations and station magnitude corrections. This article has the following objectives. 1. Using optimum methods, obtaining effective evaluations of magnitudes and station corrections employing data from the system of stations. 2. On a practical basis determine the minimum number of stations in the system on the basis of which it is possible to make a satisfactory evaluation of the magnitude in the case of failure of some of the stations or in the event of arrival of a weak signal not registered by all stations in the system. 3. Derivation of a formula for computing the dispersions and covariations of the optimum station magnitude corrections. This is necessary for comparison of the station magnitude corrections. The use of station magnitude corrections in computing magnitude evaluations usually lessens the dispersion of evaluations of magnitudes of shots and does not lead to an appreciable bias of the evaluations. The use of station dispersions of signal amplitudes, differing from one another, considerably lessens the dispersion of evaluations of magnitudes and causes a significant bias of the magnitude evaluations. The authors demonstrate the effectiveness of optimum magnitude evaluations on the basis of experimental data. The stabilization of the evaluations and their dispersions with an increase in the number of seismic stations is illustrated. Effective evaluations of parameters make it possible to compare data for different parts of the system of stations and compare data for different systems of stations. Moreover, they ensure a more precise classification of sources on the basis of intensity. Figures 3, tables 2. References 10: 9 Russian, 1 Western.

[272]

SEISMIC FISSURING IN THE GARM REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980
pp 18-29

[Article by A. A. Lukk, Institute of Physics of the Earth, "Seismic Fissuring, Erosional Network and Stressed-Strained State of the Garm Region"]

[Abstract] The article presents a joint statistical analysis of the strikes of displacement planes at the foci of weak earthquakes with $M = 1-4$ (so-called "seismic fissuring") and lineaments of the erosional network in the Garm region. In the corresponding azimuthal distributions it is possible to discriminate two systems of conjugate mutually orthogonal directions: 0 and 90° , ~ 50 and $\sim 140^\circ$. The author also investigates the dependence of the form of the compared distributions on the form of the stressed-strained state for different blocks in the earth's crust. The presented data indicate the existence of two systems of conjugate, mutually orthogonal fissures in the earth's crust in the Garm region. It is possible that there is a genetic relationship between the displacement planes at the foci of earthquakes and the erosional network, based on the presence of definitely oriented fissuring in rocks. This fissuring may represent a development of planetary fissuring in the course of seismotectonic deformation of material in the earth's crust. Figures 5, tables 1. References 34; 28 Russian, 6 Western.

[272]

EFFECT OF ERRORS IN GEODETIC MEASUREMENTS ON SEA GRAVIMETRIC SURVEY

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 2, 1980 pp 20-23

[Article by B. Ye. Ivanov, "Effect of Errors in Geodetic Measurements on the Accuracy of a Sea Gravimetric Survey"]

[Abstract] In earlier studies (GEODEZIYA I KARTOGRAFIYA, No 9, pp 25-29, 1976; No 1, pp 46-47, 1979) the author proposed expressions for computing the mean square errors in determining the parameters of a survey in the ocean caused by errors in geodetic tie-in. These formulas can be used in evaluating the accuracy of most parameters. However, in studying some parameters an allowance is made for corrections which are functions of coordinates. The error in determining such corrections is dependent on the accuracy in determining coordinates and this must be taken into account in computing the mean square error in determining parameters as a result of the error in geodetic tie-in. This must be taken into account when measuring gravity in the ocean, to which the Eötvös correction is applied, computed using the position coordinates of the ship. This paper

gives the derivation of a formula for computing the mean square error m in determining the gravity anomaly as a result of the error in geodetic tie-in. In the computations use is made of the elements of the ellipse of errors in determining position, the gravity gradient and values characterizing the relative position of measurement points. The proposed expressions can be used for a careful evaluation of the accuracy of a gravimetric survey made in the ocean, determining the optimum direction of runs, the frequency of geodetic measurements, the distances between runs and other parameters in the planning of a sea gravimetric survey. Figures 1; references: 4 Russian.

[231]

PROSPECTS FOR FINDING PETROLEUM AND GAS IN BLACK SEA-CRIMEAN REGION

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA B. GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 2, 1980 pp 32-35

[Article by Academician Ukrainian Academy of Sciences V. B. Porfir'yev, V. A. Krayushkin, V. P. Klochko, G. B. Sal'man, T. I. Dobrovol'skaya and M. M. Lusnpey, Institute of Geological Sciences Ukrainian Academy of Sciences, Ukrainian State Institute for Design and Planning and Scientific Research Institute of the Petroleum Institute, All-Union Scientific Research Institute of Foreign Geology and Institute of Mineral Resources, "Prospects of Finding Petroleum and Gas in the Heterogeneous Basement of the Black Sea-Crimean Petroleum and Gas Region"]

[Abstract] The prospects of finding petroleum and gas in the heterogeneous basement of the Black Sea-Crimean petroleum and gas region are as follows. This region takes in a diversity of tectonic elements: southern margin of the East European platform, Scythian platform and alpine mountain structure of the Crimea. Geophysical investigations indicate that the crust in this region has a complex layered-block structure and is divided by numerous faults into individual blocks. It is proposed that the petroleum and gas potential of basement rocks in the Crimean-Black Sea petroleum and gas region be studied by drilling within known deposits, within the limits of structures promising with respect to the sedimentary cover and folded complex, under nonstructural conditions and by drilling of boreholes with a depth up to 3 km in areas with a small thickness of the sedimentary cover. Specific recommendations are made on exploration of different areas and structures. A map accompanying the text shows the distribution of boreholes recommended for drilling for studying the prospects for finding petroleum and gas in this region. Figures 1; references: 3 Russian.

[280]

STRUCTURAL CHARACTERISTICS OF URAL-OMAN DEEP FAULT ZONE

Moscow GEOTEKTONIKA in Russian No 1, 1980 pp 56-71

[Article by A. V. Goryachev, Institute of Physics of the Earth, "Structure and Structural Position of Ural-Oman Zone of Deep Faults"]

[Abstract] The article gives a detailed description of the structure and history of tectonic development in the Ural-Oman zone of deep faults, consisting of a system of meridional grabens and horsts buried beneath Mesozoic and Cenozoic formations. The zone was formed in the Precambrian and was active during the entire Phanerozoic, when there was a sharp structural tectonic boundary separating the Turan epi-Paleozoic platform and the Alpine zone into western and eastern parts. These parts differed with respect to the time of consolidation of the platform basement, the intensity and sign of tectonic movements, the thicknesses and facies of Mesozoic and Cenozoic sediments, and the strike and time of formation of folding of the Alpine zone. The zone separates the epi-Hercynian Ural and the epi-Caledonian Kazakh folded country; the Alpine zone cuts across the strike in the south. It constitutes one of the ancient regmatic (planetary) fissurings of the Eurasian continent, whose deep faults, possibly, are rising to the surface from the upper mantle. In the south the Alpine zone is superposed on this fissure. The tectonic movements of the zone activated the faults in this part and as a result it became tectonically and seismically active here. Figure 1 in the text is a structural map of the region. Figures 3; references 57: 39 Russian, 18 Western.
[256]

LONG-RANGE FORECASTING OF STRONG EARTHQUAKES IN TIEN SHAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 6, 1980 pp 1352-1355

[Article by I. L. Nersesov, A. Nurmagambetov and A. Sydykov, Seismology Institute Kazakh Academy of Sciences, "Long-Range Forecasting of Strong Earthquakes in the Northern Tien Shan"]

[Abstract] In the investigation of long-range forecasting of strong earthquakes considerable attention is being devoted to study of the spatial-temporal patterns of manifestation of seismicity in a broad energy range. This paper is devoted to this problem applicable to the northern Tien Shan. The investigated region includes the Zailiyskiy and Kungey Alatau Ranges and the adjacent territory, all these among the seismically most dangerous regions in Central Asia. Instrumental seismological investigations in this territory have been made since 1928. Macroseismic data are available since 1865 for earthquakes with $M \geq 5.5$; thus, it is possible to study the earthquake record for the last 50-120 years. The entire period of

seismological investigations in the northern Tien Shan can be divided into six stages of approximately equal duration. The presented data indicate the occurrence of periods of activation and calm in the seismic activity of the region. The periods of relative calm, during which there is an accumulation of deformation, are regularly replaced by periods of seismic activation, when the accumulated deformation is released in short time intervals. In this respect the Zailiyskiy and Kungey Alatau, for which the actual variation of the curve is very close to its upper limit, are now the most seismically active zone, where a strong earthquake should be expected in the next few years. For earthquakes with $M = 6.6$ the lifetime of precursors is 1,500 days, according to the formula presented in this paper. The article gives an analysis of maps of epicenters of weak earthquakes and defines two regions of surmised seismic calm. One of these is situated to the south of "Fabrichnaya" seismic station, and the other -- in the region of "Turgen'" seismic station. Within the second region, beginning on 30 August 1969, there have been no earthquakes with $K \geq 9$, and during the last three years, even earthquakes with $K = 8$. Thus, during this calm time a period of more than nine years has passed, which is close to the time for preparation of an earthquake with $M \sim 7$. The area of this zone is about $3,000 \text{ km}^2$, which also corresponds to a region for the preparation of an earthquake with $M = 6.5-7.0$. Anomalous ratios of the velocities of longitudinal and transverse waves (v_p/v_s) are spatially associated with areas of preparation of strong earthquakes and in time precede them. For one particular epicentral region investigated (Zhalansh-Typskoye earthquake) it was found that regions of calm correspond to zones with reduced v_p/v_s values. In the Turgenskaya zone a decrease in the v_p/v_s value began in 1974-1975. It is now considerably below the background value. This fact also possibly indicates a definite probability of a strong earthquake in the central part of the Zailiyskiy and Kungey Alatau Ranges in the near future. Figures 3; references 6: 5 Russian, 1 Western.

[262]

STATISTICAL MODELS OF FORMATION OF SHORT-PERIOD GROUP Lg AND CODA

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 2, 1980
pp 22-35

[Article by Yu. F. Kopnichev, Institute of Physics of the Earth, "Statistical Models of Formation of Short-Period Group Lg and Coda and Results of Their Joint Interpretation"]

[Abstract] Lg short-period waves and their coda occupy a quite large segment of a seismogram and therefore contain much information on structure of the medium on the path from a focus to a station. However, until recently only an insignificant fraction of this information has been extracted. Accordingly, the author here proposes simple statistical models of formation of the Lg short-period group and their coda. The article examines the different processes associated with the propagation of seismic waves in the crust. On the basis of an analysis of known experimental data and very simple theoretical models the conclusion is drawn

that the most probable scheme of formation of the short-period Lg group is interference of transverse waves multiply refracted in the crust and multiply reflected from the M discontinuity at supercritical angles. A formula is proposed for describing the attenuation of energy density in the Lg group after attaining a maximum. An analysis of experimental data and comparison with the Riznichenko model of multiple reflections leads to the hypothesis of formation of the Lg short-period coda by transverse waves singly reflected from different discontinuities in the mantle. An expression is derived for the dependence of energy density in the coda on time. On the envelope of the record there must be a bend corresponding to a transition from waves multiply reflected in the crust to singly reflected in the mantle. The author also proposes methods for evaluating the absorbing characteristics of the crust and mantle and also the parameters of thin layers in the mantle from the envelope of the Lg group and coda. It was found that a model of a medium with a well-developed asthenospheric layer does not support the dynamic characteristics of the Lg coda for earthquakes to the north of the anomalous region of Tibet used as an example. This result agrees with the conclusions drawn by other authors on the discontinuity of the asthenospheric layer on the continents. Figures 1, tables 2; references 43: 31 Russian, 12 Western.
[242]

EFFECTIVENESS OF SEISMIC OBSERVATION SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 2, 1980
pp 36-43

[Article by Yu. N. Shtemenko and V. I. Tsibul'skiy, Institute of Physics of the Earth, "Evaluation of Effectiveness of Seismic Observation System"]

[Abstract] A method is proposed for determining the effectiveness of registry of seismic signals from sources of different magnitudes by the network of stations, groups of stations and a combined system of stations. (By a combined system is meant a combination of the network and groups of stations.) The following are examined in detail: effectiveness of detection by a network of stations; effectiveness of detection of a source by a group of stations; effectiveness of detection of a source by a combined system of stations; practical evaluation of effectiveness of seismic detection systems. In this examination it was possible to obtain statistical moments of two densities related to hypotheses concerning the presence or absence of signals of a certain magnitude. On the basis of these moments it was possible to ascertain the effectiveness of different seismic detection systems. In estimating magnitudes using a combined system the problem arises of determining the probable station magnitude corrections for stations in the network and for groups of stations. The method for computing such corrections for network stations was described earlier by the authors in VYCHISLITEL'NAYA SEISMOLOGIYA, 9, "Nauka," Moscow, 1976. Using this

method it is possible to find the probable corrections for different station groups. The results of this study, and an earlier investigation by the authors (STUDIA GEOPHYS. ET GEOL., 3, 1974) can be used for statistical regionalization of a territory on the basis of magnitude scales. This means that evaluations of effectiveness of registry can be considered from the point of view of the effect of sources of different magnitudes on adjacent regions. Figures 2, tables 2; references 7: 5 Russian, 2 Western.

[242]

VELOCITY OF FAULT PROPAGATION AT EARTHQUAKE FOCUS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 2, 1980
pp 82-89

[Article by R. N. Burymskaya, Sakhalin Multidiscipline Scientific Research Institute, "Velocity of Fault Propagation at Earthquake Focus"]

[Abstract] This study is devoted to the process of development of earthquake foci in the Kurile-Kamchatka and Japanese seismic zones on the basis of an analysis of the impulses in body waves registered by long-period apparatus. The investigation was made by the Vvedenskaya method, making it possible to determine a number of earthquake focal parameters: direction and dip of the fault plane, velocity and duration of fault propagation. The method was applied to 63 earthquakes with $M > 6$ from the two mentioned zones for 1962-1978 (the parameters of all these events are given in a table). The sample included 26 earthquakes which gave rise to tsunamis and 37 which did not, but which were close in their basic parameters (focal region, M , h , Δ). The study was based for the most part on records of body waves at the "Obninsk" and "Pulkovo" stations, which have a series of long-period instruments: SKD, SD-1, P-Yu, DS-BP. The results of computations of V_{prop} and τ_{prop} , the velocity and duration of propagation, as well as the extent of the fault areas, are given in the table and in Figures 3-5. The mean fault propagation velocities vary in a rather broad range for earthquakes of different intensity. For tremors with $M > 7.0$ mean V_{prop} fall in the range 1.9-4.9 km/sec, and for earthquakes of lesser intensity -- 3.1-7.8 km/sec., this greatly exceeding the velocity of transverse waves. A comparison of the absolute V_{prop} values for tremors of almost identical magnitude, but differing with respect to the danger of appearance of tsunamis, revealed that the propagation velocity for a fault giving rise to a tsunami is approximately 1.5 times less than the corresponding velocity for a fault not giving rise to a tsunami. The data made it possible to estimate the duration of the train of impulses characteristic for an earthquake generating a tsunami. Figures 5, tables 1; references 7: 4 Russian, 3 Western.

[242]

METHOD FOR DISCRIMINATING EXCHANGE WAVES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, 1979 pp 107-119

[Article by A. V. Yegorkin, T. I. Danilova and M. B. Rybalov, Scientific-Production Combine "Soyuzgeofizika," "Method for Discriminating Exchange Waves"]

[Abstract] The discrimination and correlation of waves of different types under interference conditions is one of the most complex stages in the interpretation of seismic records. The authors examine the use of two algorithms for this purpose: the Gol'tsman-Troyan optimum algorithm for the separation of interference waves and one of the modifications of a "shaping filter." The basis for both algorithms is the assumption of a virtual coincidence of the shape of the record of an exchange wave and the longitudinal (transverse) wave generating it. The proposed methods have a high effectiveness in determining the arrival time and the intensity of interfering waves having an identical shape of the record and arbitrary polarization. The reliability of the resulting data is essentially dependent on the accuracy in stipulation of the initial wave form. For selection of the latter a method was developed which is based on a comparison of the amplitude spectra (or power spectra) of the initial signal and the total path. Satisfactory results are obtained when the correlation coefficient between the indicated spectra is not less than 0.7 and the discrepancies between the values of the predominating frequency do not exceed 10%. With the correct selection of the form of the initial signal, using processing on an electronic computer, it is possible to separate waves whose arrival times differ by not less than 0.3-0.4 of the predominant period. In order to filter out spuriously discriminated waves it is necessary to make a joint analysis of a set of paths (not less than three), obtained at one and the same observation point with different sources of oscillations or with different orientation of the seismographs. Figures 7; references 21: 19 Russian, 2 Western.
[220-5303]

DIAGNOSTIC SIGNIFICANCE OF SEISMIC PREDICTION CRITERIA FOR GAS AND OIL

Kiev GEOFIZICHESKIY ZHURNAL in Russian No 1, 1980 pp 100-106

[Article by Ye. Ye. Zemtsov and N. P. Shkirman, Scientific-Production Combine "Yuzhmorgeo," "Diagnostic Significance of Criteria for the Seismic Prediction of Productivity of Structures in Different Section Intervals"]

[Abstract] Recently different procedures have been developed for predicting the presence of petroleum and gas in detected structures. In order to increase the reliability of prediction it is necessary to take into account

the characteristics of change in the criteria for indication of deposits with depth. For this purpose specialists at the Scientific Research Institute of Marine Geophysics carried out a theoretical-experimental evaluation of the acoustic properties of stratum fluids in a broad range of thermodynamic conditions and applicable to the petrophysical and structural parameters of the sandy-clayey formations of the Azov-Kuban' petroleum- and gas-bearing basin determined the distinguishing characteristics of acoustic contrast of petroleum and gas deposits to a depth of 5-6 km. The collected materials made it possible to examine some criteria for indication of deposits on the basis of the wave fields observed at the surface and applicable to the specific geological conditions of the studied region made it possible to determine the intervals of the section in which these criteria retain their diagnostic importance. The following criteria are evaluated: 1) "bright spot" criterion; 2) reflectivity of the bottom part of petroleum and gas deposits; 3) reliability of indication of petroleum and gas deposits on the basis of the velocity parameter; 4) criterion of apparent disharmony; 5) criterion of change in spectrum of reflections from thin productive stratum. Figures 5; references: 6 Russian. [211-5303]

METHOD FOR DETERMINING ABSORPTION OF SEISMIC WAVES IN OCEAN AREAS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 4, 1980 pp 838-841

[Article by A. V. Kalinin, V. V. Kalinin, L. M. Kul'nitskiy and B. L. Pivovarov, Moscow State University, "Determination of Absorption of Seismic Waves Using Data from Seismic Investigations in Ocean Areas"]

[Abstract] The authors examine a method for determining the absorption of the energy of seismic waves associated with nonideal elasticity of geological media on the basis of data from seismic investigations. The method assumes satisfaction of the following conditions: the spectral makeup of the excited oscillations is known with an accuracy to a constant factor in a finite band and is stable within the limits of some set of seismic paths and the change in the spectrum of the reflected wave occurs only due to absorption. The reflecting boundaries can be considered plane, with their slopes not exceeding 10° , and the distance between the source and receiver is small in comparison with the depth to the studied section interval. Without sacrifice for universality of the method, its possibilities are examined applicable to seismic investigations in ocean areas. Existing methods are known to be inadequate for this purpose, and therefore a different approach is formulated. Two assumptions are made: 1) The selected set of seismic paths must in an adequate number of intervals have such fluctuations in the arrival time of waves as in their value will be comparable with the duration of the excitation pulse; 2) Within the limits of the area in which this set is obtained the relative change in the horizontal absorption parameter can be considered small. The following experiment was carried out. In a deep-sea area (water depth 1.5 km) the measuring

apparatus, including a source of elastic waves and a detector, moved in a circular trajectory with a radius of about 500 m. The distance between observation points was 30 m. A total of 200 seismic paths were registered when making a double circle (probably with some deviation from a circle). The source and detector were submerged to 5 m. The spectrum of excited oscillations occupied the frequency range from 30 to 150 Hz. The duration of the excited pulse, with satellite waves taken into account, was 25 msec. The duration of the useful record from arrival of the bottom wave was 900 msec. By the use of the circular sounding method it was possible to discriminate a thin upper layer of weakly consolidated sediments, highly absorbing, whereas the underlying sedimentary rocks are virtually nonabsorbing and undifferentiated. Figures 1; references 4: 3 Russian, 1 Western. [217-5303]

PROPOSED OBSERVATIONS FOR EURASIAN UNIFORM MAGNITUDE OBSERVATION SYSTEM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 4, 1980 pp 834-837

[Article by I. Vanek, N. V. Kondorskaya, I. V. Fedorova and L. Khristoskov, Geophysical Institute Czechoslovakian Academy of Sciences and Institute of Physics of the Earth, "Optimization of Amplitude Dependences of Longitudinal Seismic Waves in a Uniform Magnitude System of Observations for the Eurasian Continent"]

[Abstract] A study of the amplitude field of seismic waves makes it possible to obtain some idea concerning the depth distribution of the velocities of seismic waves and the absorbing properties of the medium along all possible paths. The authors propose a new approach to such investigations ensuring a standardization of all amplitude observations, taking into account regional peculiarities caused by the region of the earthquake focus and the path of propagation of seismic waves from the focus to a station. Also solved is the problem of more precise determination of the calibration functions of magnitude scales $\sigma(\Delta)$ for a more precise determination of earthquake magnitudes (M) for different types of waves in accordance with the equation

$$M = \log(A/T)_{\max} + \sigma(\Delta) + S;$$

A is the maximum amplitude in a wave of a given type corresponding to $(A/T)_{\max}$; S is the station correction. A uniform magnitude system was developed for Eurasia on the basis of 32 standard stations (listed in a table). Important conditions were: a quite uniform distribution of seismic stations in the selected region, their outfitting with standard instrumentation (medium- and short-period) with similar amplitude-frequency characteristics, and choice of a group of earthquakes reflecting the typical distribution of earthquake epicenters for observation conditions in Eurasia. In the

process of developing the uniform magnitude system there was successive optimization of a system of station corrections, calibration functions and mean network magnitudes on the basis of the $\log(A/T)_{\max}$ values at standard stations for the selected group of earthquakes and a zero approximation of the calibration function $\sigma_0(\Delta)$ for a given type of wave. The station magnitudes were computed and these were used in determining the station corrections in the first approximation. Then, with these taken into account, the mean network magnitudes NM and the set of $\sigma(\Delta)$ values were determined for a first approximation of the calibration function. The proposed method for standardization of amplitude observations, after its use for other types of waves, transverse and surface, will make it possible to create a full-scale uniform magnitude system for the Eurasian continent. In order to obtain uniform data on the dynamic parameters of seismic waves for all seismically active regions on the planet it is desirable to create at least two additional continental uniform magnitude systems. Tables 1, Figures 1; references 4; 3 Russian, 1 Western. [217-5303]

FIELD MAPPING OF SEISMIC DISLOCATIONS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4, GEOLOGIYA in Russian No 5, 1979 pp 73-79

[Article by I. V. Shchukina, Department of Dynamic Geology, Moscow University, "Method for Field Mapping of Seismic Dislocations"]

[Abstract] Each year about 1,000 earthquakes of different intensity occur in the territory of Tadzhikistan; those with an intensity greater than 8 scale units are usually accompanied by deformations of the earth's surface. The mapping of these dislocations is important for seismic regionalization. In 1976 specialists of the Geology Administration Tadzhik SSR and the author carried out large-scale mapping of dislocations. This involved for the most part the mapping of gravitational-seismotectonic and seismogravitational dislocations. As an example of description of seismic dislocations and determination of their age the paper gives a description of a complex of dislocations situated near Shulkhov village. This complex consists of a hill, grabenlike structures and tectonic dislocations. For a quantitative evaluation of the dislocation of blocks the author constructed three maps of the concentration of seismic dislocations: 1) for the number of dislocations manifested at the surface without allowance for the length of the dislocations; 2) the same, with allowance for the length of the dislocations; 3) with allowance for the mean length of the dislocations. The density maps based on the number of dislocations with and without allowance for the length of seismic dislocations do not have fundamental differences and show the true pattern of the concentration of

dislocations at the surface and their orientation. The map of concentrations based on the mean length of the dislocations seemingly reflects the deep characteristics of these dislocations, frequently changing their orientation by 90° to the surface orientation of the dislocations. Since in the described region there are mostly gravitational-seismotectonic and seismogravitational dislocations with a length up to 2 km and a depth not greater than tens of meters, such a map does not reflect the true pattern of distribution of seismic dislocations at the surface. This map will be informative with identical linear dislocations with a length greater than 2 km. Diagrams of the strikes of dislocations and faults were constructed for a quantitative evaluation of the orientation of seismic dislocations and their relationship to faults. Three directions are clearly defined on the diagram of seismic dislocations: northeasterly $60-70^\circ$, latitudinal, northwesterly 290 and 320° . On the diagrams the strikes of NE, latitudinal and NW 320° directions clearly correspond to strikes of faults of different ages, whereas strikes NW 290° correspond only to dissected peaks, dissected watersheds and dissected slopes and correlate only with the strikes of the most recent faults. An attempt was made to correlate the mapped dislocations with lithological rock varieties, but no pattern could be detected. Figures 4; references: 12 Russian.
[178-5303]

DILATANCY EFFECTS ACCOMPANYING UNDERGROUND SHOT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 1, 1980 pp 66-70

[Article by V. N. Nikolayevskiy, A. N. Polyanichev, Ye. V. Sumin and N. G. Yakubovich, Moscow Physical Engineering Institute, "Dilatancy Effects Accompanying an Underground Shot. Numerical Investigation"]

[Abstract] The dilatancy phenomenon is characteristic for rocks and ground (see V. N. Nikolayevskiy, DAN, Vol 177, No 3, 1967). These effects lead to a fundamental change in the dependence of density on stressed state. In an underground unvented shot a thinning of the medium occurs behind the shock wave front and this is reflected in a marked increase in the effective seismic source. In this paper, on the basis of numerical computations, it is shown that the dilatancy thinning of the medium leads to a substantial increase in the amplitude of the shot wave and an increase in the compressional stresses in the neighborhood of the shot cavity, determined by a decrease in cavity radius. The problem is formulated, the necessary equations are derived and a specific example of the computations is given for demonstrating the above points. Figures 4; references: 10 Russian.
[182-5303]

USE OF SUPERCONDUCTING MAGNETOMETER IN GEOPHYSICAL SOUNDING

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 9, 1979 pp 103-109

[Article by Ya. I. Gitarts, N. V. Zavaritskiy, D. S. Mirinskiy, B. I. Rabinovich, S. V. Forgang and V. N. Shatokhin, Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials, "Possibility of Use of a Superconducting Magnetometer in Sounding by the Method of an Artificially Induced Field"]

[Abstract] At the present time one of the progressive directions in development of electric prospecting methods is a changeover to multicomponent measurements, especially simultaneous registry of three magnetic field components. This changeover is particularly important in the method of sounding by the use of an artificially induced field in the near zone, most commonly employed in structural and ore studies. In this method, based on study of the transient process arising in the earth after cutting off of the current at the source, until now there has been measurement only of the vertical component of the magnetic field by means of a loop situated on the ground. This limitation considerably impoverishes the possibilities of the method. This article describes a new magnetometer for geophysical prospecting which corrects this limitation. The instrument includes a helium cryostat (operating in the range 0 to 20 KHz) which has sensing elements (1 to 3, depending on the number of field components to be measured simultaneously), supplied with superconducting flux converters, and electronic circuits connected to the sensing elements by means of coaxial lines. By means of the electronic circuits the changes in peak voltage are converted into an analog signal at the instrument output proportional to changes in the measured field component. Laboratory and polygon tests indicated that the superconducting magnetometer is characterized by the following parameters: frequency range -- 0-20 KHz; linearity range -- ± 0.1 A/m; drift in 8 hours -- not more than $2 \cdot 10^{-7}$ A/m; response threshold -- $1 \cdot 10^{-8}$ A/m $\cdot \sqrt{\text{Hz}}$. The problems involved are discussed; suitable modifications were introduced. It was found that the magnetometer can be used for multicomponent measurements. One of the problems remaining unsolved is reliable field supply of liquid helium for the cryostat. Figures 3, tables 3; references 5: 4 Russian, 1 Western.

[221]

EFFECTIVENESS OF DIFFERENT ELECTROMAGNETIC METHODS FOR GEOLOGICAL STUDIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 1, 1980 pp 70-73

[Article by B. S. Enenshteyn and A. G. Tarkhnishvili, Geological Institute USSR Academy of Sciences, "Effectiveness of Different Electromagnetic Methods for Geological Investigations"]

[Abstract] The authors used different electromagnetic methods in separate determination of the two principal parameters of the geoelectric section -- the total thickness h of section layers and their mean longitudinal resistivity ρ_l in the example of a three-layered structure of the class H of the type $\mu_3 = \infty$. First the case of dipole sounding with a d-c current is considered. It is shown why such inadequate results have been obtained by this method, reasons which are also applicable to magnetotelluric sounding, magnetovariation sounding and other electromagnetic methods. The frequency electromagnetic soundings method is then examined in great detail and it is shown that it is far more effective than any other method in determining the two mentioned parameters. A specific example of such computations is presented. Nomograms are proposed for solving the problem with the frequency soundings method. Figures 3; references: 1 Russian.
[182-5303]

METHOD FOR SOLUTION OF INVERSE PROBLEM IN GRAVIMETRIC PROSPECTING

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250, No 1, 1980 pp 62-66

[Article by V. L. Danilov and I. I. Shul'man, All-Union Scientific Research Institute of Organization, Control and Economics of the Petroleum and Gas Industry, "Solution of the Inverse Problem in Gravimetric Prospecting by Stabilization Methods"]

[Abstract] Different variants have been proposed for formulating the inverse problem of gravimetric prospecting as a problem in determining stationary asymptotic behavior with $t \rightarrow \infty$ in solution of the Cauchy problem for functional equations describing the dissipative process of stabilization of a discontinuity (for example, the discontinuity of two nonmixing fluids in the case of their filtering in a porous medium). The authors propose an approach not only for ensuring regularization of the incorrect initial problem, but also making it possible to obtain effective computation algorithms. The solution presented here is a development of ideas expressed by V. L. Danilov in DAN, Vol 217, No 6, 1974. The solution is given using a specific example. The problem dealt with is three-dimensional, but it is easy to convert to a two-dimensional case. It is made clear that it is possible to obtain a broad spectrum of stabilization methods for solving the inverse problem in gravimetric prospecting having various

advantages in computations. References: 4 Russian
[182-5303]

SYSTEMS ANALYSIS APPROACH TO PROBLEMS IN GEOLOGICAL ENGINEERING

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEOLOGIYA I RAZVEDKA in
Russian No 12, 1979 pp 117-122

[Article by V. M. Voskoboynikov, Odessa State University, "Possibilities of the Systems Analysis Approach to Modern Problems in Geological Engineering"]

[Abstract] Geological engineering is more and more coming face-to-face with objects constituting complex heterogeneous ("engineering-environmental") dynamic formations in which a great number of interacting variables are related nonlinearly with the appearance of delays, cumulative effects, etc. A variety of different approaches and concepts, combined in a general systems analysis approach, can be formulated for investigating such objects, which are usually called complex systems. In this paper the author points out the timeliness of the systems analysis approach for geological engineering and defines possible means for the specific use of the advances in systems analysis in geological engineering. A table gives a comparison of some problems in systems analysis with corresponding traditional geological and geological engineering problems. All this is discussed. The author cautions that at first glance the mentioned systems analysis parameters can seem exceedingly general and far from traditional geological and geological engineering concepts. However, it is shown that such general concepts are used (implicitly, not systematically) by geologists and geological engineers in both theoretical work and in solving very specific problems. Figures 1, tables 1; references 21: 19 Russian, 2 Western. [186]

FOCAL MECHANISM OF EARTHQUAKES IN GARM REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 2, 1980
pp 10-21

[Article by A. A. Lukk, I. L. Nersesov and S. L. Yunga, Institute of Physics of the Earth, "Temporal Variations of the Focal Mechanism of Earthquakes in the Garm Region"]

[Abstract] A study was made of the temporal variations of the focal mechanism of earthquakes within the limits of uniformly deformed blocks in the earth's crust in the Garm region. The analysis included 1,415 focal

mechanisms of earthquakes during 12 years of observations. The authors examine temporal changes of the parameters for the tensor of a mean mechanism constructed on the basis of a large set of individual mechanisms and the coefficient k of similarity of some mechanisms to the mean mechanism. It is shown that there are significant variations of the informative coefficient \mathcal{E}_M , being a form characteristic for the mean mechanism tensor and the similarity coefficient k . There is a satisfactory correlation between these variations and the temporal variations of the ratio of velocities of elastic waves v_p/v_s and variations in the number N of earthquakes with the depths $H \geq 15$ km. It is postulated that the observed variations in \mathcal{E}_M , k , v_p/v_s , N reflect the dynamics of the process of seismotectonic deformation. Also examined is the problem of the relationship between the observed variations and the moments of occurrence of strong earthquakes with $M > 5$. Figures 5; references 13: 12 Russian, 1 Western. [242]

PAMIR-TIEN SHAN RECENT VERTICAL MOVEMENTS AND GRAVITATIONAL FIELD

Moscow GEOTEKTONIKA in Russian No 1, 1980 pp 3-16

[Article by M. Ye. Artem'yev and T. P. Belousov, Institute of Physics of the Earth, "Recent Vertical Movements and Gravitational Field in the Pamirs and Southern Tien Shan"]

[Abstract] Data have been obtained on the paired correlation of amplitudes of vertical movements of the earth's crust during individual recent time intervals and the intensities of gravitational anomalies in Glenn reductions and isostatic movement for the Pamir and southern Tien Shan and the zones of their joining. The article presents an analysis of the mean values of these parameters, characterizing 554 areas measuring $10 \times 15'$. It was possible to detect such peculiarities of development of vertical movements as the mean amplitudes of movements during individual time intervals, the mean velocities of movements, the degree of inheritance of movements from epoch to epoch, the differentiation of movements, the nature of the relationship between movements and the gravitational field, and the role of isostatic forces in the development of vertical movements. It is demonstrated that erosional-denudation processes and sedimentation exert a significant influence on vertical crustal movements. The author gives an evaluation of the isostatic and purely tectonic components of vertical crustal movements. The genetic closeness of the zone of contact and the southern Tien Shan is established. The principal peculiarities of development of recent tectonic movements in the Pamir, southern Tien Shan and their zone of contact are determined by the superposing of independent processes of epigeosynclinal orogenesis and neotectonic activation of Central Asia. Figures 4, tables 3; references: 27 Russian.

[256]

EQUIVALENCE IN THE INVERSE GRAVIMETRIC PROBLEM

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 2, 1980
pp 44-64

[Article by V. N. Strakhov, Institute of Physics of the Earth, "Equivalence in the Inverse Gravimetric Problem and Possibilities of its Practical Use in the Interpretation of Gravity Anomalies"]

[Abstract] The theory of interpretation of gravity anomalies is entering a new stage in its development and solution of the problems arising in the course of this development requires the proposal of new ideas and methods, particularly the formulation of an analytical foundation for the inverse gravimetric problem. These ideas and methods must have a maximum degree of universality. They must ensure analysis of the inverse problem in gravimetry and magnetometry in the space of any number of measurements and must afford a possibility for generalizations for other physical fields which can be described by linear differential equations in partial derivatives of the elliptical type. The equivalence problem is crucial in the development of theory. The objective of this investigation was to provide an expanded approach to demonstration of this assertion. The author presents what in his opinion constitute the initial principles on which the equivalence phenomenon can serve as a basis for creating new methods for solving the inverse problem in gravimetry and magnetometry. The author emphasizes that the study was written by a geophysicist for geophysicists and many of the mathematical fine points are not discussed. The paper (it will consist of four parts) contains many constructions whose rigorous mathematical validation is still lacking. The situation is likened to the status of the theory of boundary-value problems for differential equations in partial derivatives of the elliptical type in the 19th century. The two sections in this first part of the paper are: Some general principles of the theory of a potential equivalent with respect to external gravitational field to a simple layer. Representation of potential of the external field by the sum of potentials of a simple layer and volumetric masses; Volumetric distributions of mass in a stipulated region generating external fields identical to the fields of point masses and multipoles. Some examples of equivalent redistributions of sources. Figures 1; references 19: 18 Russian, 1 Western.

[242]

TEMPORAL STABILITY OF SEISMICITY IN TADZHIKISTAN

Dushanbe IZVESTIYA AKADEMII NAUK TADZHIKSKOY SSR, OTDELENIYE FIZIKO-MATEMATICHESKIKH I GEOLOGO-KHIMICHESKIKH NAUK in Russian No 4, 1979 pp 71-78

[Article by R. S. Mikaylova, Institute of Seismic-Resistant Construction and Seismology Tadzhik Academy of Sciences, "Temporal Stability of Present-Day Seismicity in the Territory of Tadzhikistan"]

[Abstract] A solution of the problem of temporal stability of present-day seismicity in Tadzhikistan is very important because quantitative data on seismicity constitute the basis for a quantitative evaluation of the seismic danger in its territory. An investigation was made using observational data for the years 1955-1970, divided into four periods of four years each. The results of this analysis of the temporal stability of seismic activity in Tadzhikistan are presented in the form: 1) of four maps of seismic activity (Fig. 2), 2) maps of fluctuation of activity (Fig. 3) and 3) graphs of change in areas of zones of equal activity during the considered four-year time periods (Fig. 4). Seismic activity maps for 1955-1958, 1959-1962, 1963-1966 and 1967-1970 are therefore now available. In details these maps are different. These differences are caused by the influence of strong earthquakes with $K = 16-17$, and also migrations and oscillations of sectors of increased activity unrelated to strong earthquakes. The general configuration of the isolines of seismic activity in the territory of Tadzhikistan on all four maps is rather close to one another, supporting the assumption usually made in seismic regionalization that there is an approximate constancy of the seismic regime of large territories over the course of rather long time intervals. Figures 4; references: 10 Russian. [275]

COMPREHENSIVE INTERPRETATION OF GEOPHYSICAL FIELDS FOR RECOGNITION OF GEOLOGICAL FEATURES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980 pp 56-68

[Article by V. N. Nikolenko, Geophysical Institute Ukrainian Academy of Sciences, "Development of a Programming System for the Comprehensive Interpretation of Geophysical Fields for Recognition of Geological Features"]

[Abstract] On the basis of review of the extensive literature, its integration and his own concepts, the author has analyzed the possibilities of recognition methods and has demonstrated that it is feasible to develop systems for the full and multisided interpretation of geophysical fields by synthesis of recognition theory and classical approaches to solution of inverse problems in geophysics. In the opinion of the author, image

recognition theory should become one of the fundamental components of a well-developed comprehensive interpretation theory. In this paper there is formulation of the basic diagnostic problem of geological mapping as a problem in geological mapping, as a problem in image recognition with self-teaching. It also includes a further development of formulation and solution of problems in geological mapping and prediction of minerals on the basis of teaching recognition systems. A systematized list of characteristics of potential fields, computed on the basis of areal observations, is presented. A two-stage procedure for selecting informative subspaces is proposed, as well as a method for the compression of information. Recognition algorithms formulated by the author are briefly described. References 48: 45 Russian, 3 Western.
[275]

EXTRAPOLATION METHOD IN RAY PROBLEM OF SEISMIC WAVE PROPAGATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980
pp 42-47

[Article by I. P. Dobrovolskiy and V. N. Fridman, Institute of Physics of the Earth, "Richardson Extrapolation Method in the Seismic Wave Propagation Ray Problem"]

[Abstract] The Cauchy problem is considered for a system of ordinary non-linear differential equations describing ray propagation in an inhomogeneous medium. In each interval velocity is approximated by a linear function and an approximate solution is obtained in the segments of precise solutions corresponding to this approximation. In such a numerical-analytical method the authors demonstrate the possibility of refining the solutions by means of extrapolation by the Richardson method (L. F. Richardson, PHILOS. TRANS. ROY. SOC., SER. A, London, 210, 307-357, 1910). The extrapolation weights are found. On the basis of the analytical solutions it is possible to obtain local interpolation functions, by means of which it is algorithmically simple to find ray intersections with a discontinuity. The fundamental formulas are identical for two- and three-dimensional problems. Tables 3; references 3: 2 Russian, 1 Western.
[272]

VELOCITY OF PROPAGATION OF TRANSVERSE WAVES IN WEST SIBERIAN PLATFORM

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, 1980 pp 117-124

[Article by B. A. Kanareykin and Zh. M. Somova, Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials, "Velocities of Propagation of Seismic Transverse Waves in the Sedimentary Cover of the Southeastern Part of the West Siberian Platform According to Data from Vertical Seismic Profiling"]

[Abstract] The article gives a generalization of the results of study of transverse waves registered by a seismic logging party of the Tomsk Geophysical Trust. An analysis was made for 15 exploration areas located in areas with different seismogeological conditions in the southeastern part of the West Siberian Platform. The velocities of transverse waves were studied using data from vertical seismic profiling of deep exploratory boreholes. Seismic oscillations were excited by shots in the boreholes and were registered only in the z component. The authors fully describe the method employed in studying the velocities of transverse waves using travel-time curves of the direct transverse wave and exchange transmitted waves of the PS type. There was found to be differences in the laws of change of mean stratum velocities of the transverse waves with depth for the western and eastern regions of the studied territory. It was possible to determine the dependence of the velocity of transverse waves on the velocity of longitudinal waves and the γ parameter ($\gamma = v_s/v_p$) on the velocity of transverse waves. Some peculiarities of the seismogeological model of the sedimentary cover are discussed with respect to the velocities of transverse waves. Figures 5; references: 10 Russian.

[274]

GAZLI EARTHQUAKE OF 17 MAY 1976

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 3, 1980 pp 3-17

[Article by V. V. Shteynberg, T. G. Ivanova and V. M. Grayzer, Institute of Physics of the Earth, "Gazli Earthquake of 17 May 1976"]

[Abstract] The Gazli earthquakes of 1976 occurred in the southwestern part of the Turanskaya Platform in a zone of earlier weak seismic activity where there had been no strong and destructive earthquakes. The earthquake of 17 May had an upthrust mechanism. Along the sublatitudinally oriented fault plane, dipping steeply to the north-northwest, the northern block experienced an uplift and the southern block dropped down. The intensity of this event in the epicentral zone attained 9-10 scale units. The area of 7-scale unit tremors was about 30,000 km². The acceleration of vertical oscillations

of the ground in the epicentral zone attained $1,300 \text{ cm/sec}^2$; the acceleration of horizontal oscillations was 700 cm/sec^2 . The high-frequency oscillations had a great intensity. The faulting evidently occurred in a "fresh" medium with a relatively high strength. This event was similar in many respects to the San Fernando earthquake of 9 February 1971. However, the Gazli earthquake differed from the San Fernando earthquake in that the first occurred in a relatively slightly seismic zone at a great depth. The fault did not emerge at the surface. The earthquake was in a region with a complex geological structure. Thus, within the limits of some platform regions which are seismically quite inactive there can be infrequent destructive earthquakes with intensive incoherent high-frequency radiation. Figures 6, tables 3; references 23: 17 Russian, 6 Western.
[272]

SYSTEM OF TECTONIC COVERS IN KAZAKHSTAN

Moscow GEOTEKTONIKA in Russian No 2, 1980 pp 78-94

[Article by V. F. Besspalov, Institute of Geological Sciences Kazakh Academy of Sciences, "System of Tectonic Covers in Kazakhstan"]

[Abstract] Crustal sectors of different origin come together in Kazakhstan: Russian Platform, miogeosynclinal and eugeosynclinal zones developing on the eastern margin of the Proterozoic Kazakhstan-East European complex, such as zones of the Siberian complex and a narrow zone evidently formed directly on a crust of the oceanic type (Zaysanskaya zone). The absence of a well-developed granodiorite complex indicates that the process of formation of a continental crust in the Zaysanskaya zone has not yet ended. The eugeosynclinal regions have the most complex structure of the upper part of the crust. At the same time it abounds in various ore deposits, a direct result of its contrasting stratified structure, on which are superposed systems of deep and intracrustal faults. In Eastern Kazakhstan and the Urals granodiorite intrusions and ore deposits are concentrated primarily in interformation cavities and especially between the basement and the cover of ophiolites, as a result of which the importance of the latter in the formation of epigenetic mineralization is very great; in part they constitute a direct source of mineralization with copper, nickel, cobalt and gold. There were two major periods of development in formation of the continental crust of eugeosynclines. 1) Oceanic, in the form of an opposition of the Proterozoic platform and the ocean; the period is divided into two stages: a) formation of a tectonic cover of ophiolites (from the direction of the ocean, from the east) at the eastern margin of the Proterozoic platform and simultaneously the appearance of island arcs -- Early Cambrian; b) development of the island arcs and deposition of graywackes at the edge of the platform during the Middle-Upper Cambrian, then formation of a tectonic cover consisting primarily of rocks carried from the

volcanic islands and shelf. 2. Geosynclinal period (Ordovician-Triassic) -- a direct continuation of the oceanic period, but the ophiolites of the tectonic cover of the Early Cambrian are unrelated to the initial complex of geosynclines, which is formed independently in the system of superposed rift structures. The cover of ophiolites is of exceptional importance as a concentrator of epigenetic mineralization. Figures 7; references: 30 Russian.

[271]

APPARATUS FOR DIRECT GATHERING OF SEISMIC DATA

Ashkhabad TURKMENSKAYA ISKRA in Russian 9 Jan 80 p 4

[Article by L. Ural'skaya]

[Text] Scientists of the Turkmen Academy of Sciences' Scientific Research Institute of Seismology, together with their colleagues at the USSR Academy of Sciences' Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, are completing the development of a new apparatus that will make it possible for seismologists to obtain digital information for the "Mir-2" computer directly under field conditions, thereby bypassing the photographic recording process.

At present, a prototype of the apparatus is being tested at the magnetic observatory in Ashkhabad.

[285-P]

IV. PHYSICS OF ATMOSPHERE

MULTIPLE LIGHT SCATTERING IN DISPERSIVE MEDIA

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 2, 1980 pp 136-145

[Article by V. P. Gorelov, V. I. Il'in and V. Kh. Khoruzhiy, "On the Theory of Multiple Scattering of Light in Dispersive Media on Spherical Particles"]

[Abstract] A study was made of the problem of transmission of a monodirectional light flux through a plane medium in which scattering occurs on spherical particles. Polarization in the scattering event is taken into account. The article discusses two approaches to computation of the optical characteristics, dependent on two angular variables. In one of them these angular variables are separated, whereas in the other they are not. The second approach is preferable in an examination of aerodispersive media. The article sets forth a possible approach for computing the internal light field in a homogeneous plane layer and the optical characteristics of a two-layered plane medium in which the separation of angular variables is not carried out. Practical recommendations are given for numerical computations in the example of water clouds. References 19: 13 Russian, 6 Western.

[243]

DETERMINING AEROSOL SCATTERING INDICATRICES IN CLOUDLESS ATMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 2, 1980 pp 146-155

[Article by V. S. Antyufeyev, A. I. Ivanov, G. Sh. Livshits, G. A. Mikhaylov, Computation Center Siberian Department USSR Academy of Sciences and Astrophysical Institute Kazakh Academy of Sciences, "Determination of Aerosol Scattering Indicatrices for the Cloudless Atmosphere in the Spectral Region 0.55-2.4 μ m"]

[Abstract] The Monte Carlo method and successive approximations method are used in obtaining a rigorous solution of the problem of determining aerosol scattering indicatrices using data from simultaneous measurements of

brightness of the cloudless sky, optical scattering indicatrices and albedo of the underlying surface. The aerosol scattering functions in the visible and near-IR spectral regions are given. The method makes it possible to carry out rigorous discrimination of aerosol scattering functions relating to the entire thickness of the atmosphere. In the interpretation of measurements from space vehicles it is necessary to have the most precise possible values of the principal optical parameters. The numerous data on these indicatrices published up to the present time can only be regarded as a quite rough approximation because they were obtained on the basis of serious simplifying assumptions and approximate computations. For this same reason there was no solid basis for using these indicatrices in standard optical models of the atmosphere. Despite limited statistical support, the data cited in this paper to a certain degree can fill these gaps. Figures 3, tables 2; references: 3 Russian. [243]

NONLINEAR SOUND ABSORPTION IN ACOUSTIC-RADIOACOUSTIC ATMOSPHERIC SOUNDING

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 2, 1980 pp 195-197

[Article by T. I. Makarova, Institute of Physics of the Atmosphere, "Nonlinear Sound Absorption in Problems of Acoustic and Radioacoustic Atmospheric Sounding"]

[Abstract] Acoustic and radioacoustic sounding of the atmosphere has come into increasing use during recent years. An evaluation of the range of sounding is usually made without taking into account that the acoustic waves cannot always be considered low-amplitude waves. The absorption coefficient of such waves is dependent on the amplitude of the acoustic pressure and on the distance travelled by the wave and can be substantially greater than the absorption coefficient of low-amplitude waves. The additional attenuation of waves of finite amplitude, which is caused by nonlinear effects associated with the generation of harmonics, results in a decrease in the strength of the received signal and a decrease in sounding range. Accordingly, the author undertook an experimental determination of the contribution of the additional absorption of a wave of finite amplitude to the total attenuation of an acoustic wave and an evaluation of its influence on operation of the radioacoustic sounding system described in an earlier paper. It was found that the nonlinear effects in waves of finite amplitude cause a substantial decrease in the altitude of sounding in comparison with the computed altitude. In the acoustic sounding problem, in which useful information is carried by the amplitude of the scattered signal, failure to take this additional absorption into account can cause large errors in determining the characteristics of turbulence in the scattering volume. Figures 2; references 14: 7 Russian, 7 Western. [243]

REFLECTION OF LIGHT PULSES FROM CLOUDS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 1, 1980 pp 49-54

[Article by B. A. Kargin, S. V. Kuznetsov and V. S. Malkova, Computation Center Siberian Department USSR Academy of Sciences, and Institute of Oceanology, "Reflection of Short Light Pulses from Clouds"]

[Abstract] An attempt is made to ascertain the relationships between the characteristics of a light pulse reflected from a cloud and some parameters of the cloud medium. A knowledge of these relationships makes it possible to determine which of the cloud cover parameters can be found from a reflected signal with a stipulated degree of reliability. An equally important problem is allowance for thin clouds in remote investigation of the ocean by optical methods. In solving these problems data must be obtained on the shape and other parameters of the light pulse reflected from clouds. In this study the distance from the source to the upper cloud cover boundary was assumed to be 200 km; for clarifying the possibilities of modeling of a space experiment similar computations were made with the source at a distance of 1 and 2 km from the upper cloud boundary, that is, in an aircraft variant. The problem was solved for conditions of one- and two-layer continuous cloud cover for different optical parameters of clouds and different characteristics of the light source and receiver. The computations were made by the Monte Carlo method at the Computation Center Siberian Department USSR Academy of Sciences. It was found that the altitude of the upper boundary of a homogeneous cloud is reliably determined from the beginning of the edge of a reflected pulse with an accuracy in the limits of several meters. Comparison of the results of computations for clouds at different levels above the earth's surface revealed that the reflected signal is dependent only on cloud thickness, not on its altitude. As in the case of a water cloud, the beginning of the edge of a pulse reflected from any ice cloud shows a very sharp increase in the intensity of radiation by 1-1.5 order of magnitude. In contrast to a water cloud, the beginning of the edge is not the maximum point of the pulse; there is some increase in the reflected intensity in the course of several thousands of nanoseconds. Signals from ice clouds of different thicknesses are approximately equal in strength. Despite the presence of an ice cloud aloft, the signal from a water cloud situated beneath it can be detected very clearly. The reflection from the intercloud layer is caused by the scattering of source radiation in the aerosol medium. These and other results presented in the paper can be used in the interpretation of signals registered in laser sounding of the cloudy atmosphere. Figures 5; references 15: 9 Russian, 6 Western.

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SOLUTION OF RADIATION TRANSFER EQUATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian
Vol 16, No 1, 1980 pp 55-64

[Article by L. S. Dolin, Institute of Applied Physics, "Solution of the Radiation Transfer Equation in a Small-Angle Approximation for a Stratified Turbid Medium With Allowance for Photon Path Dispersion"]

[Abstract] The author has found a solution of the radiation transfer equation in a small-angle approximation describing the propagation of a narrow modulated light beam in a layered-inhomogeneous turbid medium with allowance for photon path dispersion. After formulating the problem, the following are considered: successive approximations method for complex phase of brightness spectrum; refined solution of transfer equation in small-angle approximation; total strength of stationary beam; angular divergence of beam; effective width of beam; frequency-contrast characteristic of scattering layer; parameters of pulsed signal. On the basis of the materials presented here the author gives simple analytical expressions for a number of integral parameters of the beam. References 18: 15 Russian, 3 Western.

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V. ARCTIC AND ANTARCTIC RESEARCH

IL-18 MAKES EXPERIMENTAL FLIGHT TO ANTARCTICA

Moscow TASS in English 1719 GMT 13 Feb 80

[Text] Leningrad, 13 February -- An Aeroflot liner Il-18 landed on the snow airfield of the Soviet Antarctic observatory Molodezhnaya at 1435 hours Moscow time. Thus, the Moscow-Antarctica transcontinental air route, 15,992 kilometers long, has been laid.

The new flight to the ice continent is the third one in the history of Soviet Antarctic research. The flight route has been for the first time laid along the shortest way which ran almost meridionally via the Middle East, Africa and the Indian Ocean. This became possible due to the completion of construction of a compressed snow runway capable of receiving heavy planes at Molodezhnaya.

The unexplored latitudes over the sea expanses from Maputo, the capital of Mozambique, to Molodezhnaya were the most complex section of the route. The research vessel "Professor Vize" was used to transmit prompt forecasts and reports on weather in the open ocean to aboard the plane. A radio message received in Leningrad says that weather favored the air pilots. The crew headed by pilot Anatoliy Denisov brilliantly accomplished the mission. The entire flight from Africa to Antarctica took 8 hours 24 minutes. Polar researchers, scientists, specialists of the Soviet Committee on Hydrometeorology and Environmental Monitoring and the USSR Civil Aviation Ministry became the participants in the air expedition.

The experimental flight along the Moscow-Antarctic air route proved the possibility of a quick contact of Soviet scientific observatories and stations with the motherland and rapid replacement of wintering groups and seasonal research parties.

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